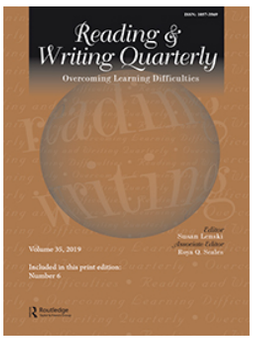

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Exploring Heterogeneity in the Relationship between Reading Engagement and Reading Comprehension by Achievement Level

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ABSTRACT

The present study examined potential synergistic relationships between reading engagement and reading comprehension among 3,689 third and fourth graders across 59 schools in North Carolina. Using hierarchical regression analyses, we replicated previous findings that reading engagement explains unique variance in reading comprehension. Our results indicated that reading engagement explained an additional 4% of variance in end-of-year reading comprehension above and beyond initial skill, student demographics, and school membership. We then utilized multilevel modeling to examine the tenability of two common hypotheses in the literature: that reading engagement is more strongly related to the reading comprehension of below-average readers (the compensatory hypothesis) and that reading engagement is more strongly related to the reading comprehension of above-average or competent readers (the cognitive-constraint hypothesis). Students were broken into above-average, average, and below-average skill groups based on their beginning-of-year score on a nationally normed assessment of reading comprehension. Results supported the cognitive-constraint hypothesis that the relationship between reading engagement and reading comprehension is attenuated for below-average readers. The strength of the relationship for average and above-average readers did not significantly differ, suggesting homogeneity in the strength of the relationship among these students.

Introduction

Reading engagement is sometimes simply conceptualized as print exposure (Mol & Bus, 2011) or reading amount (Guthrie, Wigfield, Metsala, & Cox, 1999; Schaffner, Schiefele, & Ulferts, 2013), but it can also take a broader scope (Guthrie & Wigfield, 2000). The broader view of reading engagement seeks to capture observable actions related to the behavioral, motivational, and cognitive processes that encourage reading achievement and growth. Seminal research focusing on the cognitive and motivational dimensions of this broader view of reading engagement emphasizes that engaged reading requires the collective and simultaneous work of motivational and cognitive processes and separating them is ill advised (Guthrie & Wigfield, 2000; Taboada, Tonks, Wigfield, & Guthrie, 2009).

Research has demonstrated that the variety of conceptualizations of reading engagement contributes significantly to reading comprehension, especially for students in late elementary grades and beyond (Guthrie & Klauda, 2015; Klauda & Guthrie, 2015; Wang & Guthrie, 2004). Several studies suggest that when conceptualized as reading amount, reading engagement plays an

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undeniable role in readers' success (Guthrie et al., 1999; Schaffner et al., 2013). Stanovich famously contended that reading amount is the lever that drives the widening divide between high- and low-performing readers over time (i.e., "Matthew Effects"; Stanovich, 1986). In the current study, we draw on Guthrie and Wigfield's (2000) conceptualization of reading engagement, which goes beyond reading amount to explore the motivational, cognitive, and behavioral forces at play in engaged reading. Research utilizing a similar conceptualization suggests a strong connection between this broader view of reading engagement and achievement as well. For example, Guthrie and Wigfield (2000) report positive, significant relationships between this view of reading engagement and reading comprehension, notably arguing that reading engagement can "substantially compensate" (p. 404) for low-socioeconomic students' particular susceptibility to reading difficulties (e.g., Chall, Jacobs, & Baldwin, 2009). Guthrie and Klauda (2015) similarly affirm the importance of this view of reading engagement, asserting that research has shown that it is associated with reading achievement across all stages of schooling, even college.

In addition, research also suggests that when integrated as an explicit target of curricula, the broader view of reading engagement can be a powerful means of enhancing reading achievement. For example, Wigfield et al. (2008) explored Concept-Oriented Reading Instruction (CORI), a reading intervention that integrates reading with science and social studies and is grounded in Guthrie and Wigfield's (2000) engagement model of reading development. The authors report that students' reading engagement mediated the relationship between CORI and students' reading comprehension and strategy use outcomes, suggesting that the positive impacts of CORI on reading achievement were attributable to its impacts on students' levels of reading engagement during instruction. Similarly, Kim et al.'s (2017) evaluation of the Strategic Adolescent Reading Intervention (STARI), a reading intervention for struggling adolescent readers similarly inspired by the Guthrie and Wigfield engagement model, found that that even when controlling for highly predictive variables like reader prior skill and school quality, students' reading engagement explained unique variance. Although reading engagement is a hypothesized lever of change in many intervention programs, empirical research suggests that there may be a synergistic relationship between reading achievement and reading engagement.

Exploring potential synergistic relationships between reading achievement and reading engagement

Studies of the relationship between reading achievement and reading engagement typically assume homogeneity in the strength of the relationship across subgroups. This assumption could be especially tenuous when comparing students of average or above-average reading skill with those of below-average reading skill. The extant literature on potential heterogeneity in the relationship between reading engagement and reading achievement by reader skill level is currently quite limited. However, there have been some studies that explore heterogeneity in the relationship between reading achievement and a construct quite related to reading engagement—reading motivation. Like reading engagement, there are a number of different conceptualizations of reading motivation in the field (Schiefele et al., 2012; Unrau & Quirk, 2014). Reading motivation often describes the motives and processes that propel a student to read, often including intrinsic and extrinsic motivational dimensions, and references to students' goals, self-efficacy, perceptions, values, interests, and contexts (Wigfield, 1997; Wigfield & Guthrie, 1997). It is also often conceptualized as either a prerequisite or a critical piece of reading engagement (e.g. Guthrie & Klauda, 2015). Notwithstanding the diverse views in the literature on how conceptualizations of motivation and engagement should or should not overlap (Fredricks & McColskey, 2012), the definition of reading engagement utilized in this study sees reading motivation as an essential component of reading engagement. As such, we've included findings on potential synergistic

relationships between reading achievement and reading motivation in our discussion to aid in our hypothesis generation about reading engagement.

The literature has hypothesized that the relationships between reading achievement and reading engagement and/or reading motivation may differ through two opposing processes. One hypothesis emphasizes the *compensatory* role of these constructs in potentially reducing gaps in reading comprehension between good and poor readers. Consistent with this hypothesis, some argue that the relationships between reading achievement and reading engagement or reading motivation could be stronger for lower-performing readers because these readers' comprehension is more reliant on their reading engagement and reading motivation.

For example, Logan, Medford, and Hughes (2011) lend support to this argument, proposing that reading motivation is likely more strongly related to lower-achieving readers' achievement because lower-achieving readers require higher reading motivation to persist through the cognitive challenges they face when reading grade-level text. They argue that for on-level or above-average readers, this level of persistence may not be required for them to successfully complete a reading activity. Accordingly, the authors' study of 9–11-year-old readers reported that intrinsic motivation explained significant variance in reading comprehension for lower-achieving readers, but not higher-ability ones. Liebfreund and Conradi (2016), suggest a similar pattern. In their study of third- through fifth-grade readers, they find that intrinsic motivation predicted reading comprehension for students below the median, but not students above it. Sideridis, Mouzaki, Simos, and Protopapas's (2006) work also supports the theorized stronger relationship for lower-performing readers. Their findings suggest that the heightened importance of reading motivation for lower-achieving readers derives from the increased variation in motivation among such students and the fact that they are more likely to have low motivation than their higher-achieving peers. The authors' study of second- and fourth-grade readers finds that some dimensions of intrinsic reading motivation are related to the reading skill of poor readers, but not readers scoring above the mean.

Conversely, a competing hypothesis emphasizes the *cognitive constraints* on the relationship between reading comprehension and reading engagement or reading motivation (Klauda & Guthrie, 2015; Paris, 2005). Consistent with this hypothesis, researchers have argued that the reading motivation and reading engagement of struggling readers may have a weaker relationship to reading achievement because such students face cognitive challenges in engaging with reading tasks that limit the impacts of high motivation and engagement on their achievement and growth.

For example, Saarnio, Oka, and Paris (1990) find that reading motivation predicts high-achieving fifth-graders' reading comprehension, but not low-achieving fifth-graders' comprehension, and that reading motivation is not predictive of high- or low-achieving third-graders' reading comprehension. They assert that students' levels of reading self-concept and reading self-efficacy, concepts related to their reading motivation, can only substantively impact their reading-comprehension skill level when students do not struggle with decoding—a skill on-level students are expected to be fluent in by fourth grade. Paris and Oka (1986) suggest a similar pattern, reporting that reading motivation and self-concept are related to the reading comprehension of high- and average achieving fifth-grade students and high achieving third-grade students, but not average-achieving fifth-grade students and low-achieving third- and fifth-grade students. In their sample, they find that younger and lower-achieving students' reliance on basic reading comprehension strategies crowded out the influence of motivational variables. Klauda and Guthrie (2015) extend these findings to seventh-grade readers, and included reading engagement alongside reading motivation in their analyses. They found evidence of weaker associations among reading achievement, reading motivation, and reading engagement for lower-achieving readers, which they argue are due to cognitive challenges the struggling readers face.

Figure 1 illustrates the hypothesized differences between the compensatory and cognitive-constraint hypotheses. The graphs included draw from those used in a study comparing similar

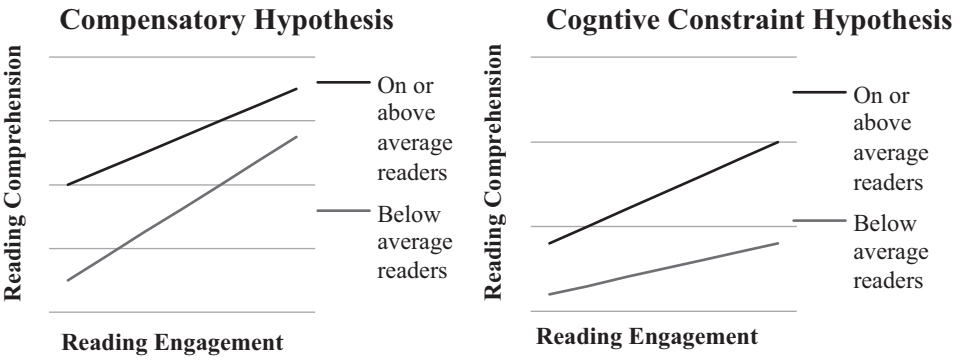

Figure 1. Hypothesized graphical models of the compensatory and cognitive constraint hypotheses.

hypotheses in relation to Head Start outcomes (Miller, Farkas, Love Vandell, & Duncan, 2014). As is shown, according to the compensatory hypothesis, empirical results would suggest stronger associations between reading comprehension and reading motivation or reading engagement for initially lower-performing readers than higher-performing readers. According to the cognitive-constraints hypothesis, the empirical results would suggest weaker associations between reading comprehension and reading motivation or reading engagement for struggling readers.

These opposing hypotheses call for additional research that further investigates how these dynamics manifest in practice and the tenability of each hypothesis. The current correlational study builds on the limited existing research, expanding the literature's laser focus on reading motivation to reading engagement, closely related constructs given our conceptualization of reading engagement. Our use of nationally normed scores to create achievement groups allows for a more generalizable understanding of below-average, average, and above-average readers. Moreover, the inclusion of these three groups as opposed to just a high and a low group also allows us to explore whether there is a significant decrease or increase in the strength of the relationship from not only below-average readers to average readers, but also from average readers to above-average readers. This way, we can disentangle whether there are increasing or decreasing benefits to reading engagement with increasing reading comprehension skill, or if we see evidence of potential threshold effects. Several studies have suggested that student self-reports can be flawed representations of students' motivation and engagement (e.g., Fulmer & Frijters, 2009). Although teacher reports are not without their own limitations, our use of teacher ratings is a novel contribution. Our sample of over 3,500 predominately low-income, ethnic-racially diverse students in urban, suburban, and rural contexts represents a population of students who often struggle with reading the most (e.g., Chall et al., 2009), and are the frequent focus of reading intervention and education policy. Finally, our sample of third- and fourth-grade readers captures an important period of transition in reading development (Goldman & Snow, 2015).

The present study

The present study seeks to replicate previous findings on the relationship between reading engagement and reading achievement and also seeks to examine achievement-level differences in the relationship between reading comprehension and reading engagement. Specifically, we address the following two questions:

1. Does reading engagement explain unique variance in spring reading comprehension above and beyond prior fall reading comprehension, school membership, and student demographic characteristics?

2. Is there a synergistic association between reading engagement and reading comprehension? In other words, does the relationship between spring reading engagement and spring reading comprehension meaningfully differ for above-average, average, and below-average readers, controlling for previous fall reading comprehension, student demographic characteristics, and students teacher's mean rating of student reading engagement?

Method

Study context and participants

We draw on data from a larger longitudinal study of an experimental summer reading intervention that targeted summer reading achievement loss in elementary students from low-income households (Kim et al., 2016). Data collection began in spring 2013. The original study included students from 59 schools in seven districts across North Carolina. Two of the districts were metropolitan, including suburban and center-city schools; three of the districts were mid-sized, urban districts; and two districts were rural. Thirty-nine of the included schools were designated high-poverty (75–100% free and reduced-price lunch [FRL]) and twenty were designated moderate-poverty schools (61–74% FRL). Of the 6,383 second- and third-grade students in the study, a majority identified as racial minorities (76%) and received FRL (77%). Students of all reading levels were included in the study, not just struggling readers.

As a part of the READS intervention, consented students were randomly assigned to receive reading lessons during the last weeks of school in spring 2013, along with 10 self-selected books matched to their reading level and preferences in the mail each week of summer 2013. Control students received math lessons in spring 2013, but received their matched books in fall 2013. The following spring and summer, the original students, now in third and fourth grade, continued in the study and all students, regardless of previous assignment, received the READS intervention (e.g., received matched books over the summer). Reading assessments from The Iowa Test of Basic Skills (ITBS) were administered the spring before and fall after each summer of the READS intervention to gauge the impact of summer loss.

For the present study, we used a subsample of third- and fourth-grade students ($n = 3{,}689$) who attended the 59 schools involved in the READS intervention in the 2013–2014 school year and whose teachers completed the Reading Engagement Index (REI) on them in spring 2014. We focus on Time 3 (T3) to Time 4 (T4), fall 2013 to spring 2014, rather than time points at the beginning and end of a summer of the intervention to better capture when teachers had regular interaction with students. During this school year of the multiyear intervention, all students, regardless of prior control or treatment status, received the same READS treatment (i.e., reading lessons at the end of the school year and matched books). All teachers were asked to complete the REI and offered a gift card as incentive. The subsample was similar in composition to the full sample. *T*-tests revealed that students whose teacher did or did not complete the REI on them did not differ in terms of their baseline reading comprehension or spring reading comprehension. This suggests that the unsampled and sampled groups did not differ in terms of either beginning- or end-of-year performance. Table 1 summarizes the characteristics of the students in our sample.

Measures

Reading comprehension

The Iowa Test of Basic Skills, Reading Comprehension (ITBS) was administered to students at the beginning and end of the 2013–2014 school year. Students in the third grade were administered Level 9, Form A and students in the fourth grade were administered Level 10, Form A. The

Table 1. Sample average reading comprehension and demographic characteristics.

Characteristics	*n*	Mean	*SD*	%
Reading comprehension				
Fall 2013 ITBS	3,561	177.20	24.16	
Spring 2014 ITBS	3,568	188.68	25.34	
Grade				
Third	2,064			55.95
Fourth	1,625			44.05
Gender				
Male	1,750			47.44
Female	1,939			52.56
Free and reduced priced lunch	2,748			74.49
English-language learner	667			18.08
Race/Ethnicity				
White	968			26.24
Black	1,262			34.21
Latino	837			22.69
Other	595			16.13

Note. ITBS = Iowa Test of Basic Skills.

reading comprehension section asks students to read a variety of reading passages covering such genres as poetry, narrative, and nonfiction (Hoover et al., 2003). Students then answer four to seven multiple-choice questions to demonstrate their ability to summarize, make inferences, and identify facts. ITBS is a reliable assessment, reporting KR-20 coefficients above .93 and equivalent form estimates of .86 and above. Schools and districts across the United States use the ITBS to measure student achievement and progress, allowing for comparison with a nationally representative sample of students.

The ITBS offers a variety of student measures in addition to their standardized score, including their national percentile rank and their national stanine. In this study, we chose to use the national stanine to create our achievement groups. The ITBS-assigned stanines split students into nine achievement groups, follow a normal distribution, and represent how each student compares to others who took the test during the same window nationally (Houghton Mifflin Harcourt, 2017). Students' stanine scores range from 1–9. The ITBS designates scores of 1–3 as *below average*, 4–6 as *average*, and 7–9 as *above average*. Due to the normal distribution of stanine assignment, *average* stanine scores roughly cover the middle 50 percentiles of scores.

Reading engagement

In this study, the Reading Engagement Index (REI) was used to capture student reading engagement. The REI is a robust, domain-general teacher-reported measure of students' engagement with reading in their classroom (Taboada Barber et al., 2018; Wigfield & Guthrie, 2017; Wigfield et al., 2008). Previous research suggests that the REI is associated with student self-reports of reading motivation (Wigfield et al., 2008). In addition, studies employing the REI have confirmed that the measure relates with reading achievement (Kim et al., 2016; Taboada, Townsend, & Boynton, 2013; Wigfield et al., 2008). There was similar evidence of validity in our sample; the REI was significantly correlated with end of school year reading comprehension ($r(3568) = .64$, $p < .001$). Cronbach's α reliability for the REI in our sample was .93, comparable to prior research (e.g., Guthrie, McCrae, & Klauda, 2007; Wigfield et al., 2008).

The REI has multiple dimensions and teachers rate students on a variety of cognitive, motivational, and behavioral characteristics, making it an attractive measure for those interested in exploring the broader concept of reading engagement (Wigfield et al., 2008). The eight-item measure includes: (A) often reads independently; (B) reads favorite topics and authors, (C) is easily distracted in self-selected reading (reverse coded), (D) works hard in reading, (E) is a confident reader, (F) uses comprehension strategies well, (G), thinks deeply about the content of texts,

and (H) enjoys discussing books with peers. While items B, C, E, and H strike at motivational aspects of reading engagement, items D and G indicate cognitive aspects, and item A points to behavioral aspects (Unrau & Quirk, 2014). Teachers rate students on each item on a scale of 1 = *not true* to 4 = *very true*. Teacher's rating of each student's reading engagement on the eight items results in a total score of 8 to 32. Higher scores suggest higher engagement in reading.

For the intervention, teachers rated students in spring 2014, the end of the school year. In our analyses, in order to help adjust for systematic differences in student reading engagement ratings based on their specific rater, their homeroom teacher, we opted to include classroom-level random intercepts. Since teachers were not normed across classrooms and schools, we also created a classroom-level control for each teacher's average rating for their class.

Student characteristics

We included five student demographic characteristics as controls in our analysis. These included gender (1 = *male*, 0 = *female*), English-language learner (ELL) (0 = no, 1 = yes), free and reduced-price lunch status (FRL) (0 = no, 1 = yes), and grade (0 = 3rd, 1 = 4th). We also accounted for students' race/ethnicity, with dummy variables for White, Black, Latinx, and other (e.g., Asian, Pacific Islander, Native American, and multiracial). This information came from school administrative records. Baker and Wigfield (1999) find differences in reading motivation, an element of reading engagement, by gender, ethnicity, family income, and age. Controlling for these possible confounders alongside ELL status, an important factor to consider when measuring students' reading achievement (August & Shanahan, 2006), will help reduce bias when estimating the relationship between reading engagement and reading achievement.

Analysis

Analyses were conducted in Stata 15.1. To address our first research question on the unique variance in spring reading comprehension explained by reading engagement, we utilized hierarchical regression analysis. To address our second research question on achievement-level group differences in the relationship between reading engagement and reading comprehension, we employed multilevel modeling. Given that our primary variable of interest was a teacher-rated measure of student reading engagement, we chose to account for student clustering at the classroom level by allowing classroom intercepts to vary randomly. Roughly 7% of the 3,689 student observations were incomplete. Specifically, 3.47% of fall ITBS testing data, 3.28% of spring ITBS testing data, and 1.25% of student homeroom teacher data were missing. All other data used in analyses were 100% complete. To reduce potential bias from the missing data, we utilized multiple imputation with chained equations in Stata 15.1 (i.e., 'mi impute chained command), which pools together results from 20 imputed datasets (StataCorp, 2017). Multiple imputation is recognized as a robust technique to address missing data, particularly in comparison with more traditional methods such as list-wise deletion (Peugh & Enders, 2004).

To create achievement groups, students were placed into above-average, average, and below-average groups using their fall 2013 ITBS reading-comprehension national stanine. National stanine scores ranged from 1–9, with 1–3 designated as *below average*, 4–6 designated as *average*, and 7–9 designated as *above average*. We chose to use fall 2013 scores instead of spring 2014 scores in order to follow the trend in the extant literature of using baseline data to create achievement groups (e.g., Saarnio et al., 1990).

We conducted hierarchical multiple regression analyses to address our first research question. Specifically, we examined whether teachers' ratings of students' reading engagement explained unique variance in spring reading comprehension score, controlling for prior reading achievement, school membership, and student demographic characteristics. Students' prior reading

achievement was captured by their fall 2013 ITBS reading-comprehension scaled score, and the full set of demographic controls included gender, FRL status, ELL status, race/ethnicity, and grade.

In order to address our second research question, we fit a series of multilevel random intercepts models. In order to help adjust for systematic differences in student reading engagement ratings based on their specific rater, their homeroom teacher, we opted to include classroom-level random intercepts. Model 1, which was our null model, included students' baseline reading comprehension scores and student demographic controls. Its primary purpose was to allow for comparison to our subsequent models that included our variable of interest, reading engagement, and related interaction terms.

Model 2 built on Model 1 and included students' REI rating and their class's average REI rating. Adding interaction terms in subsequent models rendered our model main effects unadvisable to interpret because our reference group then fell outside the scope of our data (Whisman & McClelland, 2005). Therefore, fitting Model 2 allowed us to consider the main effects of students' reading engagement to spring reading comprehension in our study.

Model 3 included interaction terms to explore our second research question, whether the relationships between reading engagement and reading comprehension differed by our designated below-average, average, and above-average achievement groupings. This model was as follows:

$$\begin{aligned}\text{SpringITBS}_{ij} = {} & \beta_{0j} + \beta_1\text{FallITBS}_{ij} + \beta_2\text{REIAverage}_{ij} + \beta_3\text{ClassREI}_j + \beta_4\text{Male}_{ij} \\ & + \text{B}_5\text{FRL}_{ij} + \beta_6\text{ELL}_{ij} + \text{B}_7\text{Latinx} + \text{B}_8\text{Black}_{ij} + \text{B}_9\text{Other}_{ij} \\ & + \text{B}_{10}\text{grade}_{ij} + \beta_{11}\text{HSReading}_{ij} + \beta_{12}\text{LSReading}_{\text{ij}} + \beta_{13}\text{HSREI}_{ij} \\ & + \beta_{14}\text{LSREI}_{ij} + \varepsilon_{ij} \\ & B_{0j} = \gamma_{00} + u_{0j} \\ & \varepsilon_{ij} \sim N\left(0,\ \sigma_\varepsilon^2\right) \\ & u_{0j} \sim \ \left(0,\ \sigma_u^2\right)\end{aligned}$$

where SpringITBS is students' spring ITBS reading-comprehension score and FallITBS is their fall 2013 ITBS score. REI is students' REI rating, which represents their reading engagement, and ClassREI is students teacher's mean REI rating for his or her full class. Covering dummy-coded student demographics: Male is gender; FRL is free and reduced-price lunch status; ELL is English-language learner status; Latinx, Black, and Other are the student's race/ethnicity; and grade is whether or not the student is in fourth grade. Covering subgroups and interactions terms, HSreading is above-average stanine readers, LSreading is below-average stanine readers, LSREI is the interaction term for REI rating and below-average stanine, and HSREI is the interaction term for REI rating and above-average stanine. ε_{ij} represents the student-specific residual. In terms of the random elements of our model, β_{0j} represents the classroom-specific intercept, where γ_{00} represents the average spring reading comprehension of the average classroom, and u_{0j} represents the class specific offset. Both ε_{ij} and u_{0j} are normally distributed with a mean of zero.

Although we drew our estimate of the main effect of reading engagement on spring reading comprehension from Model 2, we still expected β_2 in Model 3 to be positive and significant. Given this significant relationship, a positive significant value for β_{13} or β_{14} would indicate that the relationship between reading engagement and spring reading comprehension was stronger for that subgroup than average readers, the reference group. Accordingly, a negative value would indicate that the relationship is weaker for that subgroup than the reference group. Average readers were chosen as the reference group given the limited number of studies in the existing literature that compare both above-average and below-average readers to average ones.

Finally, for sensitivity analysis, we fit a fourth model with a more liberal view of above-average and below-average readers. We changed the specification of above average to being assigned to stanine 6–9, and below average, stanine 1–4. This meant that average only represented students in stanine 5, roughly the middle 20% of students (Houghton Mifflin Harcourt, 2017). The model remained the same as the model equation above, only differing in its specification of above average and below average. We included this model to test whether the previous model's findings held for a wider specification of below- and above-average readers, or whether our findings only held for the more extreme specifications of below and above average. Alternatively, if the relations still held in the more liberally specified model, it would expand our understanding of the potential threshold effects.

Results

Descriptive statistics

Table 2 presents the sample data by achievement-level groupings. In terms of performance, although the bulk of students in our sample fell within average performance, student performance overall skewed toward below-average performance, with more than twice as many students in the below- than above-average range. This skew was unsurprising given that the schools in the original study as well as our subsample were predominately high poverty—students who attend such schools often struggle academically because the schools are less focused on rigorous academics, have access to fewer resources, and have fewer experienced teachers (RAND Reading Study Group, 2002). Since groups were made using baseline reading-comprehension data, fall 2013 ITBS average performance predictably increased with achievement-level grouping, as did spring ITBS scores. REI rating also increased with achievement level grouping. In the sample overall, REI ratings ranged from 8–32, the full range of the scale, with a mean of 22.15 and standard deviation of 6.67.

In terms of student demographics, third- and fourth-grade students were similarly spread across achievement-level grouping, although a higher percentage of fourth-graders were represented in the above-average group. Overall, girls outperformed boys; for example, while only 29.34% of girls were in the below-average group, 40.47% of boys were. There were four times as many students on FRL in the below-average than the above-average group. Similarly, students with ELL status were most likely to be in the below-average group. In terms of race/ethnicity, the

Table 2. Descriptive statistics for fall and spring reading comprehension, REI rating, and student demographics by student baseline (Fall 2013) achievement-level grouping.

Variable	Below average (*n* = 1,233)	Average (*n* = 1,817)	Above average (*n* = 511)
		Means (SD)	
Fall 2013 ITBS	154.20 (9.12)	181.36 (13.05)	217.93 (16.23)
Spring 2014 ITBS	168.46 (15.76)	193.24 (18.45)	222.69 (21.15)
REI Rating	17.14 (5.47)	23.76 (5.49)	28.86 (3.83)
		Counts (%)	
Grade 3	701 (35.40%)	1,024 (51.67%)	256 (12.92%)
Grade 4	532 (33.67%)	793 (50.19%)	255 (16.14%)
Male	684 (40.47%)	792 (46.86%)	214 (12.67%)
Female	549 (29.34%)	1,025 (54.78%)	297 (15.87%)
Free and reduced priced lunch	1,071 (40.48%)	1,321 (49.92%)	254 (9.60%)
English-language Learner	361 (56.49%)	258 (40.38%)	20 (.03%)
White	220 (23.23%)	472 (49.84%)	255 (26.93%)
Black	453 (37.47%)	636 (52.61%)	120 (9.93%)
Latino	361 (44.90%)	386 (48.01%)	57 (7.09%)
Other	187 (32.47%)	310 (53.82%)	79 (13.72%)

Note. Percentages represent what percent of each demographic characteristic group is in each achievement level grouping. ITBS = Iowa Test of Basic Skills; REI = Reading Engagement Index.

Table 3. Correlation table of fall and spring reading comprehension and REI rating.

Variable	1	2	3
1. Spring 2014 ITBS	–		
2. Fall 2013 ITBS	.80***	–	
3. REI rating	.64***	.60***	

Note. ITBS = Iowa Test of Basic Skills Reading Comprehension; REI = Reading Engagement Index.
***$p < .001$

groups were markedly uneven. While the White students were essentially evenly distributed across groups, Black, Latinx, and all "other" students were not. Although these groups all had roughly half of students in the average range, the remaining students were far more likely to be below average than above average. The general imbalance of student demographic groups across achievement groups supports our choice to include them as controls in our analyses.

Table 3 presents the correlations for the non-dichotomous variables in our analysis. Predictably, fall 2013 reading comprehension scores were strongly and significantly related to spring scores. REI rating was strongly and significantly correlated to both fall and spring scores, suggesting that our prediction of a positive relationship is well grounded.

Research Question 1: Additional variance in reading comprehension explained by reading engagement

Table 4 presents the results of our hierarchical multiple regression analyses. These analyses explored whether teachers' ratings for students' reading engagement explained unique variance in their spring reading-comprehension scores controlling for prior reading achievement, school membership, and student demographics, including race/ethnicity, gender, English-language proficiency, FRL status, and grade. The results in Table 4 indicate that students' reading engagement explained roughly 4% additional variance in spring reading comprehension, controlling for students' prior fall reading comprehension, school membership, and student demographics.

Research Question 2: Synergistic associations between reading engagement and reading comprehension

Table 5 presents the coefficients for four multilevel random intercepts models. Model 1 is our null model, with only prior achievement and student demographics predicting spring reading comprehension. Model 2 included students' REI rating as well as their class's REI rating and allowed for interpretability of main effects without the presence of interaction terms. In Model 2 we see the predicted positive and significant relationship between student's REI rating and spring reading comprehension ($\beta = 1.11,\ p < .001$). Interestingly, this model reports that being an ELL, having FRL status, and being non-White were associated with lower spring reading comprehension, controlling for fall reading comprehension, reading engagement, and other demographic characteristics. In addition, being in fourth grade was associated with higher spring reading comprehension controlling for fall comprehension, reading engagement, and other student demographics, but being a boy was not statistically significantly associated with a higher or lower score controlling for other variables.

Model 3 addresses our second research question, and the coefficients on the included interaction terms are of particular interest. The interaction between reading engagement and being a below-average reader reached statistical significance ($\beta = -.51,\ p < .001$), suggesting a weaker relationship between reading engagement and reading comprehension for below-average readers. In the sample, being an above-average reader was associated with a stronger relationship between reading engagement and reading comprehension but this failed to meet statistical significance ($\beta = .36,\ p = .09$).

Table 4. Hierarchical multiple regression analyses predicting spring reading comprehension from prior fall reading comprehension, school membership, and student demographics ($n = 3689$).

Model and Entry Step	R^2	ΔR^2	β	ΔF	p
1. Prior reading comprehension	.65		.80		
2. School	.66	.01		2.29	$< .001$
3. Student demographics	.67	.01		7.10	$< .001$
4. Reading Engagement (REI)	.71	.04	.27	460.61	$< .001$

Table 5. Random intercepts models predicting differences in the relationship between REI rating and student spring 2014 reading comprehension by achievement subgroup ($n = 3689$).

Model	(1) $b(SE)$	(2) $b(SE)$	(3) $b(SE)$	(4) $b(SE)$
Fall 2013 reading comprehension	.81*** (.01)	.60*** (.02)	.58*** (.03)	.58*** (.02)
Male	−.69 (.49)	.81 (.45)	.79 (.45)	.82 (.45)
FRL	−3.04*** (.67)	−1.94** (.64)	−1.77** (.65)	−1.76** (.63)
ELL	−1.53 (.80)	−2.05** (.78)	−1.87* (.77)	−2.06* (.78)
Latinx	−2.42** (.88)	−3.03** (.88)	−2.99** (.88)	−2.93** (.88)
Black	−4.60*** (.70)	−3.69*** (.69)	−3.65*** (.70)	−3.60*** (.72)
Other	−2.34** (.83)	−2.38** (.79)	−2.41** (.79)	−2.29** (.79)
Grade 4	−.53 (.63)	3.25*** (.66)	3.49*** (.75)	3.55*** (.69)
REI rating		1.11 (.06)***	1.27*** (.06)	1.32*** (.12)
Class average REI rating		−.26* (.13)	−.25* (.12)	−.25* (1.12)
Above average (AA)			−10.66 (6.16)	−3.41 (4.07)
Below average (BA)			8.95*** (2.05)	6.23* (3.21)
Average REI x AA			.36 (.21)	.08 (.16)
Average REI x BA			−.51*** (.10)	−.36** (.13)
Intercept	51.37*** (2.59)	66.13*** (3.63)	64.69*** (5.45)	64.52*** (5.73)
		Random parameters		
σ^2_u (Intercept)	2.52 (.40)	3.48 (.37)	3.46 (.38)	3.45 (.39)
σ^2_ε (Residuals)	14.63 (.22)	13.55 (.20)	13.46 (.20)	13.54 (.20)

Note. Unstandardized regression coefficients with cluster robust standard errors in parentheses. FRL = free and reduced-priced lunch; ELL = English-language learner; REI = Reading Engagement Index.
*$p < .05$; **$p < .01$; ***$p < .001$.

In Model 4, we explored if a more liberal specification of below- or above-average readers would change the nature of the interactions observed in Model 3. The interaction between reading engagement and being a below-average reader remained statistically significant but decreased in magnitude ($\beta = -.36,\ p = .01$). The magnitude of the difference in relationship between reading comprehension and reading engagement for above-average readers compared to average ones decreased and remained statistically insignificant ($\beta = .08,\ p = .59$).

Discussion

Prior studies on reading engagement have often assumed homogeneity in the relationship between reading engagement and reading achievement. Subgroup level differences in the strength, significance, or direction of this relationship are consistently overlooked. This correlational study replicated previous work that illustrated that reading engagement accounts for unique variance in reading comprehension. This study also expanded on the prior work on reading engagement by exploring potentially synergistic associations between reading engagement and reading comprehension for third- and fourth-grade readers. We interacted students' reading engagement with their baseline reading comprehension skill level to address this question.

Our study replicates Kim et al.'s (2017) previous finding that reading engagement, a malleable factor, explains unique variance in students' reading achievement. Kim et al.'s (2017) study included sixth- to eighth-grade students, so the present study extends the finding to a younger population of students—third- and fourth-grade students. In both our studies, reading engagement explained 4% additional variance in students' reading comprehension. While Kim et al.

(2017) found that reading engagement explained 4% additional variance controlling for previous reading comprehension and school, the current study also controlled for student demographics, including their race/ethnicity, ELL status, gender, grade, and FRL status.

Although we replicate prior research highlighting the unique role of reading engagement in predicting later reading comprehension, we extend prior research by exploring potentially synergistic associations between engagement and comprehension in the context of upper-elementary-grade classroom instruction. In doing so, we shed light on empirical results that support the notion that there are cognitive constraints that attenuate the relationship between engagement and comprehension for less-skilled readers (e.g., Klauda & Guthrie, 2015; Paris, 2005). This study finds that the relationship between reading engagement and reading comprehension is weaker for below-average third- and fourth-grade readers when compared to average readers of the same grades. We explored two specifications of below-average reading achievement and found a statistically significant interaction with student reading engagement for both, suggesting heterogeneity in the strength of the relationship for below-average readers compared to average ones. We believe that our use of a broader view of reading engagement, which was informed by motivational, cognitive, and behavioral contributors to reading engagement, influenced our results in support of the cognitive-constraint hypothesis. We imagine that exhibiting these competencies in tandem is both essential for reading success and more difficult for lower-performing readers. Had we focused on just one element of engagement, it is possible the patterns may have differed.

Our results also show that the relationship between reading engagement and reading comprehension did not differ significantly for above-average readers in comparison to average readers, suggesting homogeneity in the relationship for these two groups of readers. This was the case in both interaction models, Model 3 and Model 4. This finding is important because it suggests that there may not be a consistently increasing benefit of baseline reading comprehension when it comes to reaping the benefits of reading engagement. Taken together with the findings for below-average readers, these findings suggest that potentially, once students have a certain threshold of reading-comprehension skill, the relationship between reading engagement and comprehension manifests itself similarly; however, before that point, the strength of the relationship is undermined by students' below-average achievement. More research is needed that explores the existence of this potential threshold effect. If confirmed, these findings would provide empirical evidence for Stanovich's (1986) argument that reading engagement is one of the driving forces of the widening gap (i.e., Matthew Effects) in achievement between struggling and successful readers over time. His conceptualization of reading engagement largely centered on print exposure, and our findings suggest that the widening process may be consistent with the broader view of reading engagement as well.

The study's main findings are illustrated in Figure 2 and are broadly consistent with the cognitive-constraint hypothesis illustrated in Figure 1. Figure 2 shows the prototypical lines for the relationships between reading engagement and reading comprehension for prototypical above-average, average, and below-average readers using results from Model 3 and each achievement group's mean fall 2013 reading-comprehension score. As is shown, the gap in predicted spring comprehension scores between below and above-average readers is smaller for children with low REI scores than high REI scores. In other words, the skill gap is larger for children of different initial reading levels with higher levels of reading engagement than it is for differently skilled children with lower levels of reading engagement. The illustrated skill gap is due to the weaker relationship between reading engagement and reading comprehension for below-average readers compared to average ones, which begets a widening gap in reading comprehension as reading engagement increases. Although it visually appears that this pattern may transfer to above-average compared to average readers, the differences in relationship between these groups was not significant. This supports the idea that once the cognitive constraint is gone, the relationship between

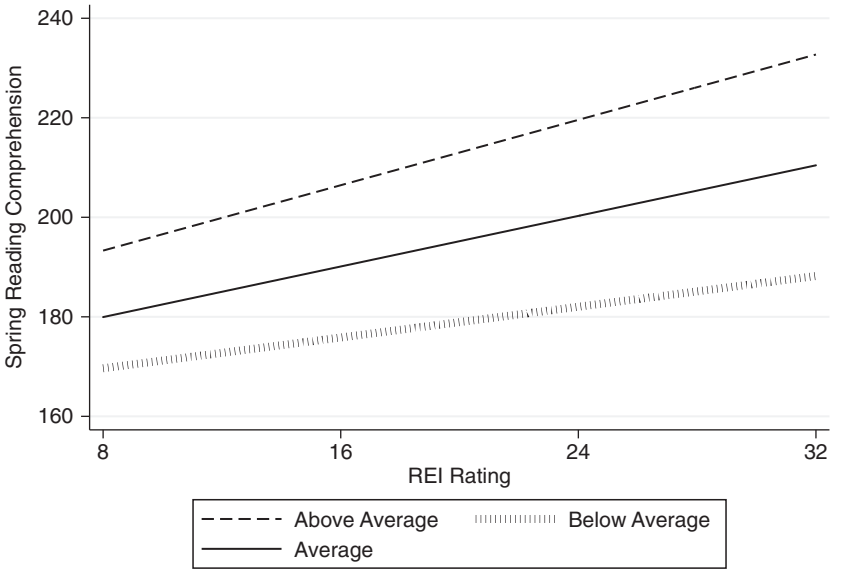

Figure 2. Comparison of the relationship between reading engagement and reading comprehension for above-average (~ >75th percentile), average (~ middle 50 percentiles), and below-average (~ <25th percentile) readers. The relationship for below-average readers is statistically significantly different from the relationship for average readers ($p < .001$), but the relationship for above-average readers is not statistically significantly different from the relationship for average readers.

reading engagement and reading comprehension operates similarly across readers of various skill levels.

Our correlational findings complement previous findings in support of the cognitive-constraint hypothesis (e.g., Klauda & Guthrie, 2015; Paris & Oka, 1986; Saarnio et al., 1990). These authors' works all suggested that weaker readers' struggles with comprehension crowd out the influence of their reading motivation on their reading achievement. Reading motivation is a dimension of reading engagement as we have conceptualized it in our study, so our findings expand this body of work. Our study findings also complement Klauda and Guthrie's (2015) findings that a measure of reading engagement, reading avoidance, was more weakly related to the reading achievement of struggling seventh-grade readers compared to high-achieving ones. Our work builds on this finding by extending it to a younger sample and including a broader conceptualization of reading engagement that incorporates motivational, cognitive, and behavioral dimensions. Overall, this work contributes to the burgeoning literature on how reading engagement manifests in different subsets of students in late elementary school and beyond.

Our findings contrast sharply with researchers who found evidence in support of the compensatory hypothesis, which posits stronger relationships between reading skill and reading motivation for lower-performing students (e.g., Liebfreund & Conradi, 2016; Logan et al., 2011; Sideridis et al., 2006). In the case of Logan et al. (2011) and Liebfreund and Conradi (2016), this difference may be due to our conceptualization of reading engagement. Ours included several dimensions beyond intrinsic motivation, which these authors focused on and was the narrowest conceptualization of reading motivation in the reviewed studies. In the case of Sideridis et al. (2006), their study focused on a similar age of students as the present study (second and fourth grade), but they split their sample to compare only the bottom 10% of readers and all above-average readers—this was the narrowest conceptualization of below average in the reviewed studies. Our below-average grouping criteria was far less extreme, and our inclusion of all students could have also influenced the difference in our study findings. It is also possible that our use of teacher reports and the fact that the REI is a broad, domain-general measure influenced our different

results. Perhaps, if we asked teachers to focus specifically on students' intrinsic motivation and enjoyment of reading, or used a more task- or text- specific, self-report measure of motivation rather than our much broader concept of reading engagement, we may have found different results.

It is important to note that while the relationship is weaker for the struggling readers, the relationship is not null. Models 3 and 4's findings illustrate that students' struggles with reading do not completely impede their ability to reap the benefits of higher reading engagement. Rather than take the study findings as a strike against the importance of reading engagement for all students, we should instead seek to better understand through additional research and practice how to more effectively support the reading engagement of late-elementary struggling readers and what additional cognitive-skill supports they may need in conjunction with engagement-focused intervention. It is possible, for example, that mastery of constrained reading skills like fluency (Paris, 2005) at some threshold could support the further development of less-skilled readers' reading engagement and passage comprehension outcomes.

Limitations and directions for future research

There are limitations to this study that offer future directions for subsequent research. First, we only had student reading-engagement data at one time point, the spring. Future research should include multiple waves of data to allow a better understanding of how growth or decline in reading engagement over the course of a school year relates to students' reading growth across achievement levels. Exploring growth trajectories over several years could also provide us a deeper understanding of how the relationship between reading engagement and reading achievement develops over time, particularly in the sensitive late-elementary and post-primary years.

Another limitation of our study is its single measure of reading engagement. The teachers in our study reported on students' reading engagement after a full year of experience with their students. Still, including student self-reports, interviews, or observational data as well could help more fully capture students' reading engagement. Triangulation would help to address the larger disagreement in the field about how, and from who's perspective, we should gather engagement data and whether these different methods provide complementary or divergent results (Fredricks & McCloskey, 2012). Although research suggests that teacher reports can be especially useful for studying younger children (Fredricks & McCloskey, 2012), the research also suggests that while teachers are good at identifying students behavioral engagement in learning, they struggle to accurately capture other forms of students' engagement, like their emotional engagement (Skinner, Marchand, Furrer, & Kinderman, 2008). Although items from the REI have been found to positively and significantly correlate with student-reported motivation measures (Wigfield et al., 2008), it is certainly possible that teachers' ratings diverge from students' true perspectives. In addition, Ivey and Johnston (2013) approached reading engagement from a sociocultural lens, arguing that engaged reading cannot be reduced to individual cognitive factors and must also attend to the social and relational nature of reading development. Therefore, it would potentially benefit us to explore social-network and relational measures in tandem with student and teacher reports of engagement as well.

Another limitation is that our analyses and findings do not explicitly consider how teachers' specific curriculum or classroom environments shaped students' engagement. The differences found in the current analysis may be sensitive to differences in the curricula or classroom contexts the students in the study experienced. Guthrie and Wigfield (2000) underscore the role that teachers and classroom contexts can play in students' reading engagement through such pedagogical tools as co-developed learning and knowledge goals, real-world interactions, autonomy support, interesting texts, strategy instruction, student collaboration, evaluation, teacher involvement, and praise and rewards. It would be worthwhile to consider specific curricula, focused on

building students' reading engagement (e.g., Wigfield et al., 2008), and see if our observed difference in the strength of the relationship persists. If yes, it would be helpful to then parse out the motivational, cognitive, and behavioral dimensions of the reading engagement, and see which, if not all three, drive heterogeneity in the strength of the relationship. This future research would provide valuable information for classroom-based interventions.

Conclusion

Despite the limitations in our study, our findings provide compelling evidence for the cognitive-constraints hypothesis that the relationship between reading engagement and reading comprehension is weaker for struggling readers in the upper-elementary grades. The study adds important nuance to the research literature within reading engagement exploring subgroup differences. It is one of the few studies to consider heterogeneity in the relationship between reading achievement and reading engagement, a shift from the more popular focus on heterogeneity in the relationship between reading achievement and reading motivation (e.g., Saarnio et al., 1990). Further research should continue to examine potential threshold effects of reading engagement and reading achievement utilizing a variety of triangulated measures to help ensure a more holistic understanding of potential synergistic relationships is developed.

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